

The Sources of Mercury (Hg) to the Sediments of Whatcom County Lakes

Presented by

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Objectives

**Examine Hg sedimentation to
Whatcom County lakes and
compare global atmospheric
sources to local sources**

Outline

- **Atmospheric Sources of Hg**
 - Global
 - Local
- **Sediment Cores from six Whatcom County lakes**

Global Atmospheric Deposition of Hg

(from National Atmospheric Deposition Program)

Year	Hg Deposition ($\mu\text{g}/\text{square meter}$)	Avg. Hg conc. (ng/L)
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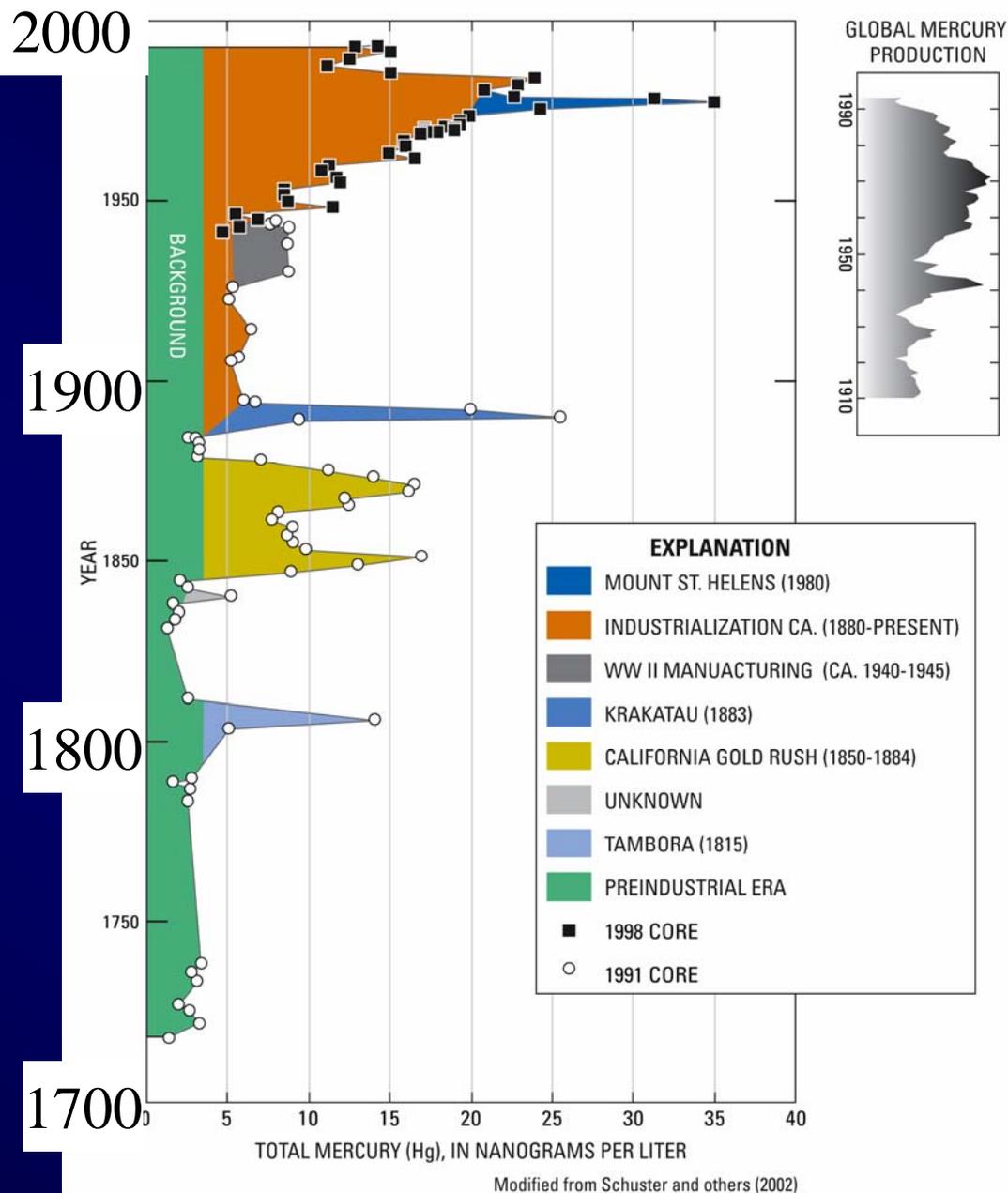
Seattle

1997	17.3	18.3
1998	5.3	5.9
1999	8.0	8.5
2000	6.2	9.8
2001	5.9	6.3
2002	5.7	9.1

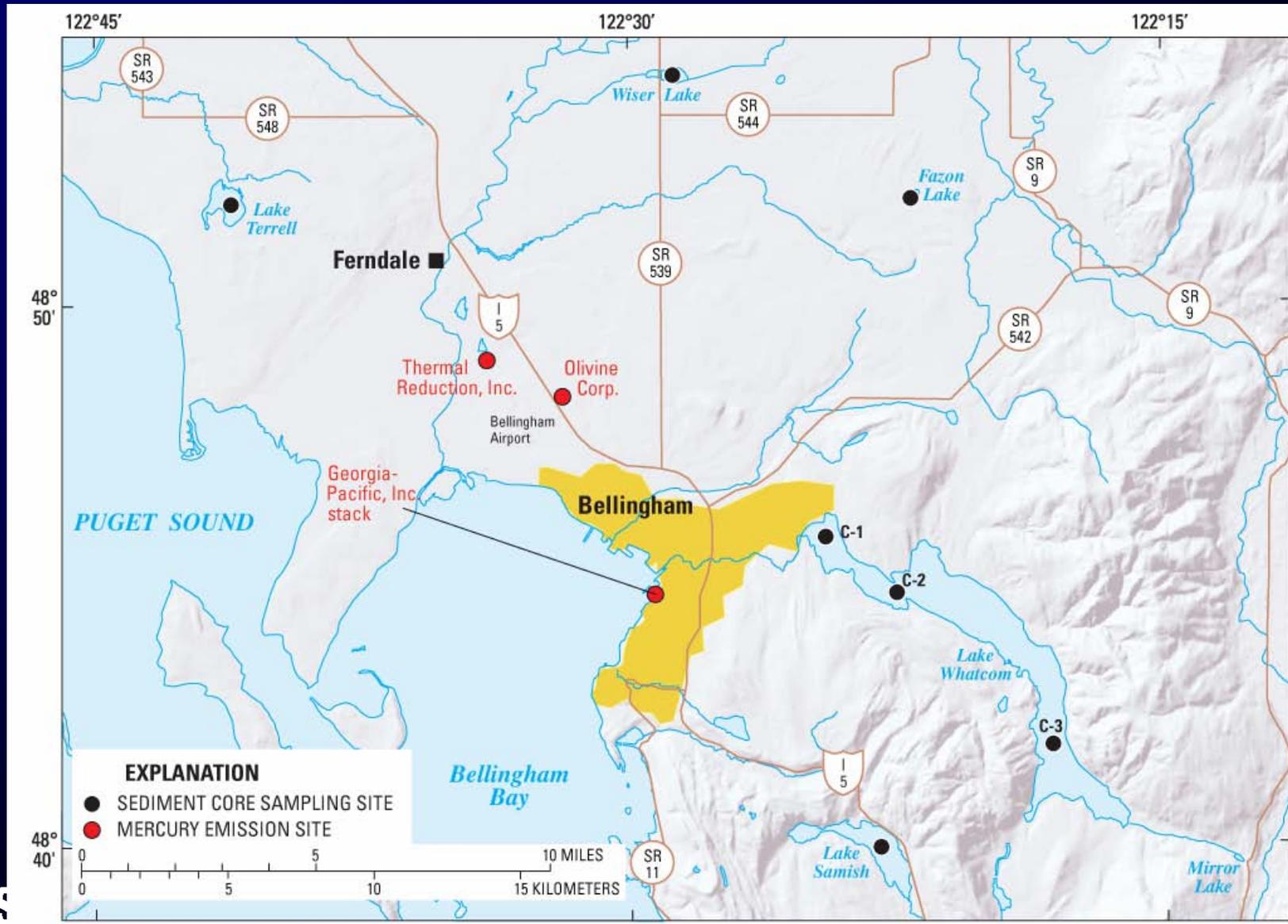
Reifle Island, B.C., reference site

2001	5.5	6.0
2002	3.2	4.8

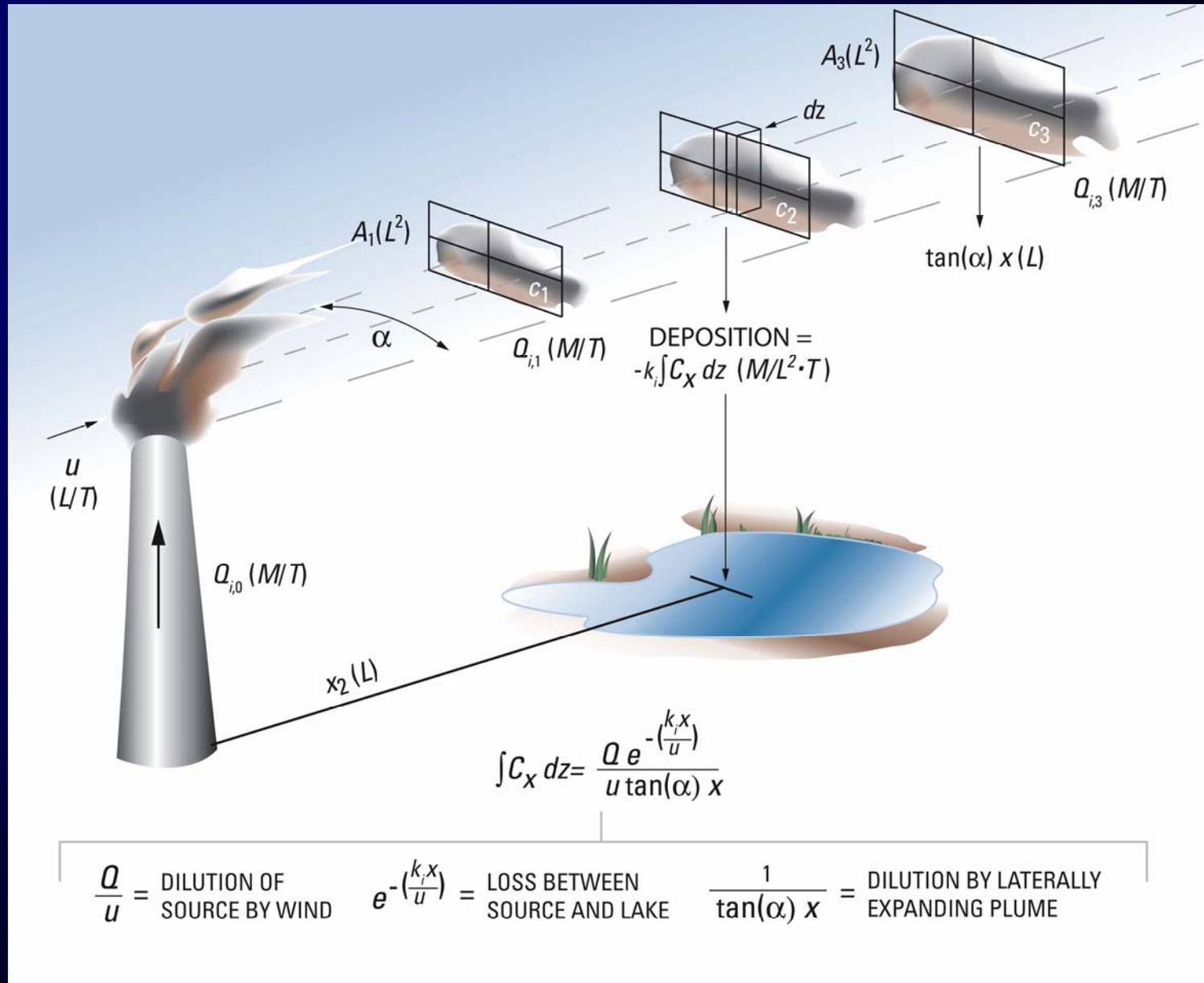
History of Hg deposition in a ice core from a Wyoming glacier



Sources of Atmospheric Hg to Whatcom County



Conceptual model of transport and deposition of Hg from emitters



Deposition estimates based on models requires knowing:

Source & Receptor Independent Factors

- Atmospheric Half-life of Hg species
 - Particulate Hg- locally deposited (1 day)
 - Reactive Gaseous Hg (RGM)- regionally deposited (1 week)
 - Vaporous Atomic Hg-globally deposited (3 months)
- Wind speed and direction

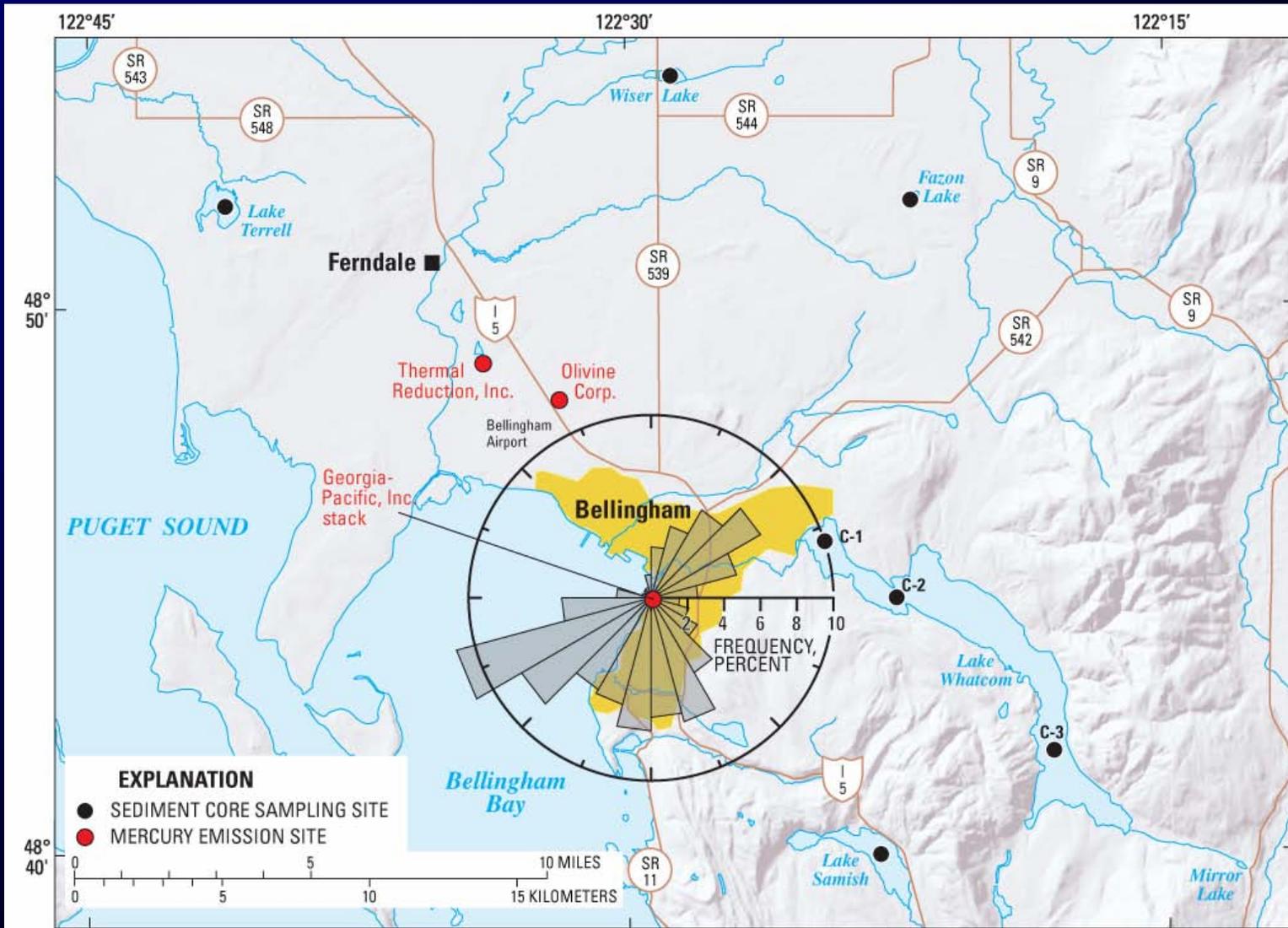
Source Dependent and Receptor Independent Factors

- Hg emission rates
- Speciation of Hg in the emissions

Receptor Dependent Factors

- Angle between Source and Receptor (for winds)
- Distance between Source and Receptor

Sources of Atmospheric Hg to Whatcom County with Wind rose at Georgia-Pacific, Inc. Plant



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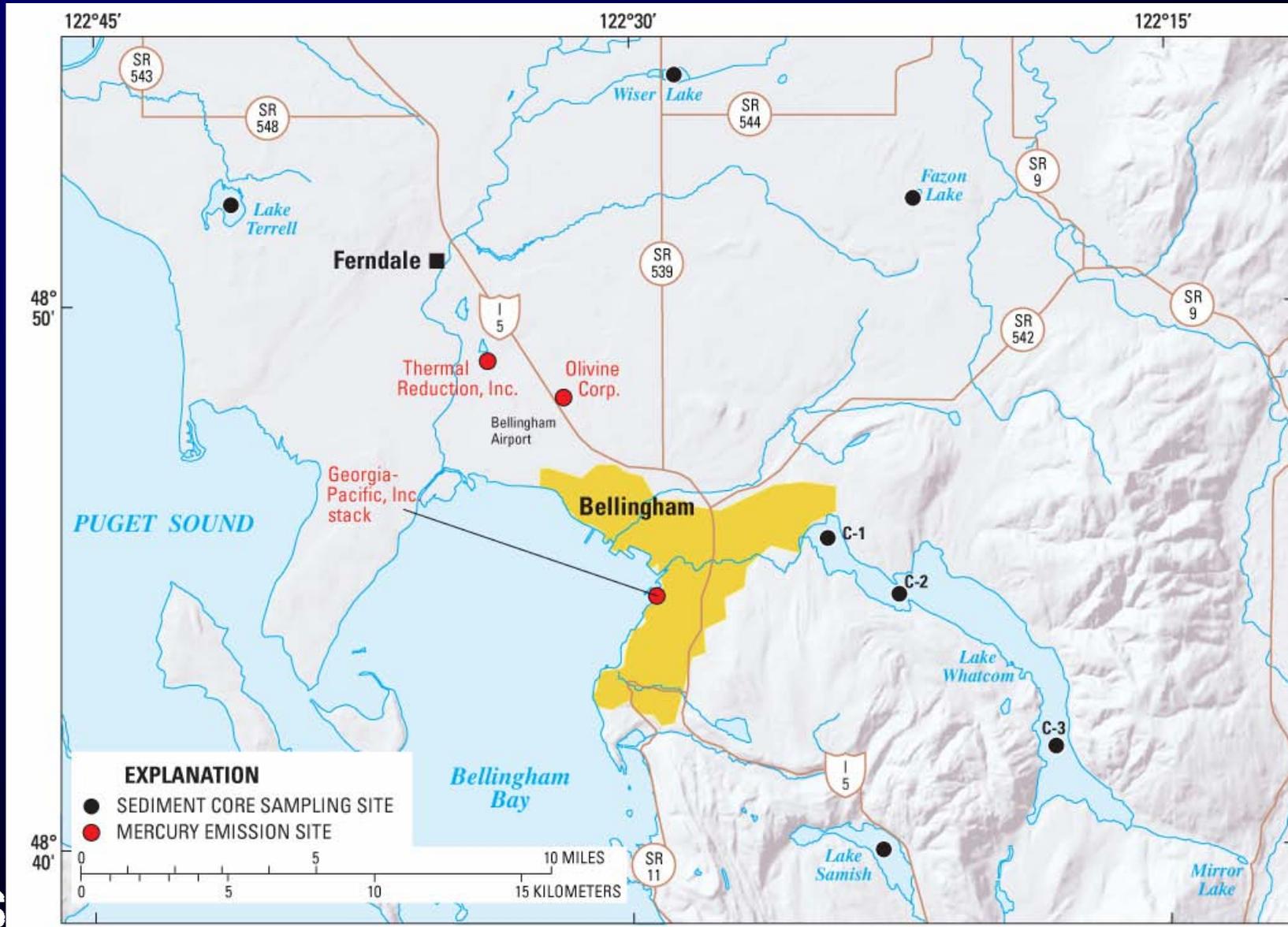
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Receptor Dependent Factors

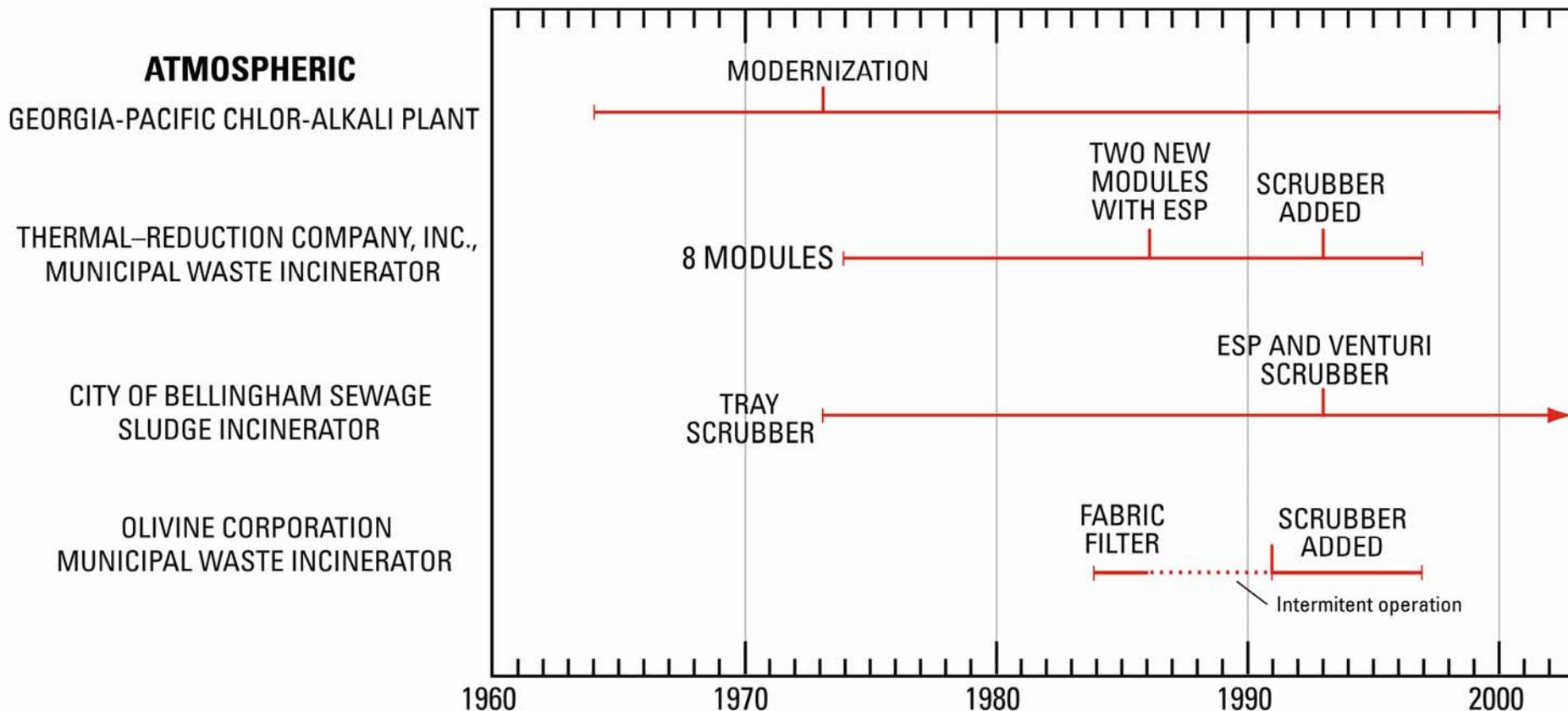
- Angle between Source and Receptor (for winds)
- Distance between Source and Receptor

Emissions and Forms of Atmospheric Hg to Whatcom County



Present and Historical Sources of Local Atmospheric Hg

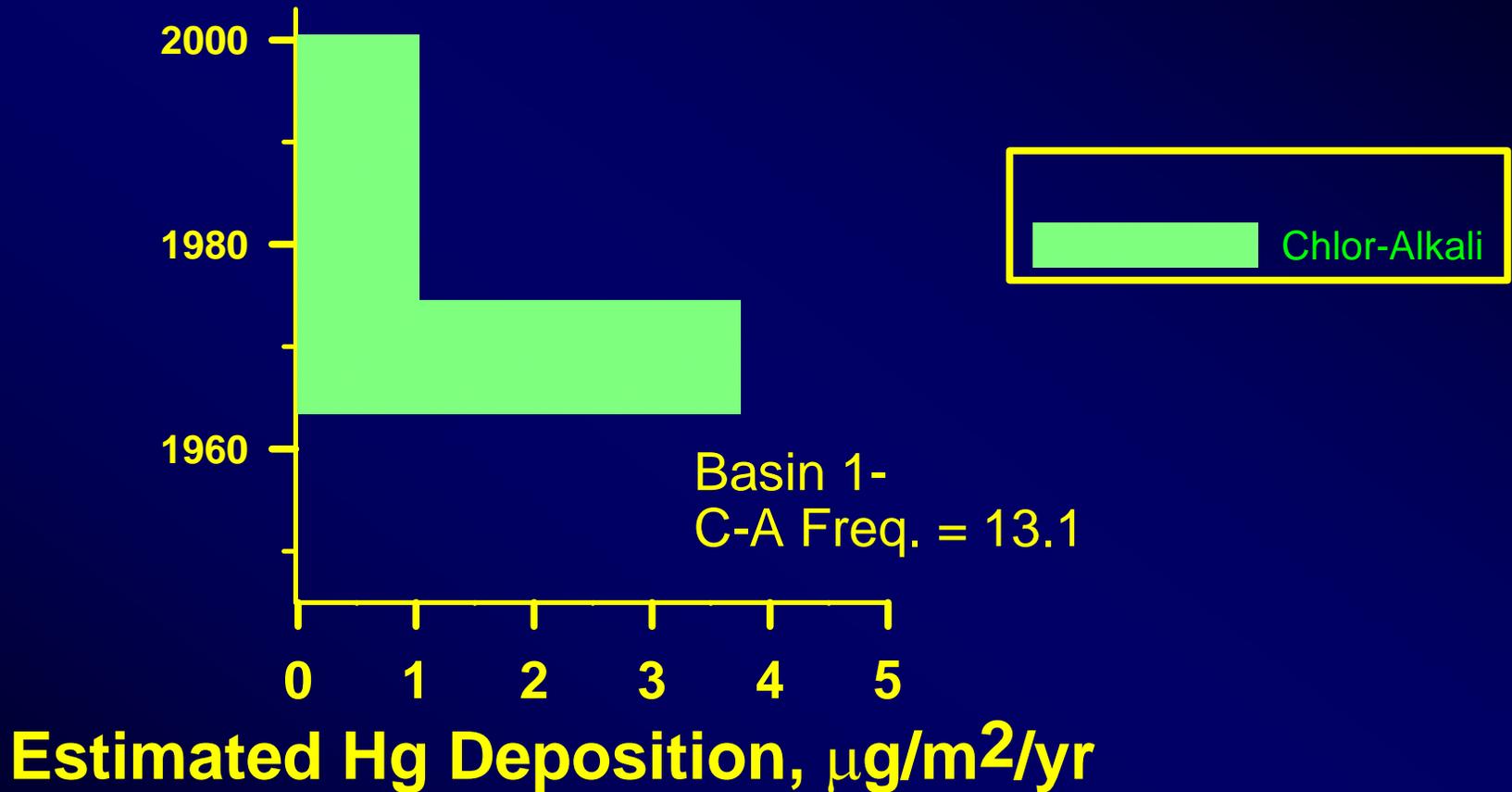
TIME LINES FOR MERCURY (Hg) SOURCES TO LAKE WHATCOM



Hg from Chlor-Alkali Plant

- Cell room emissions- 20 g/hr with 2% being RGM
- Chlorine production- 5.7 g/hr until late 1970s (100% RGM)
- Alkali production- could not assess because gas stream burn in lignin spray dryer

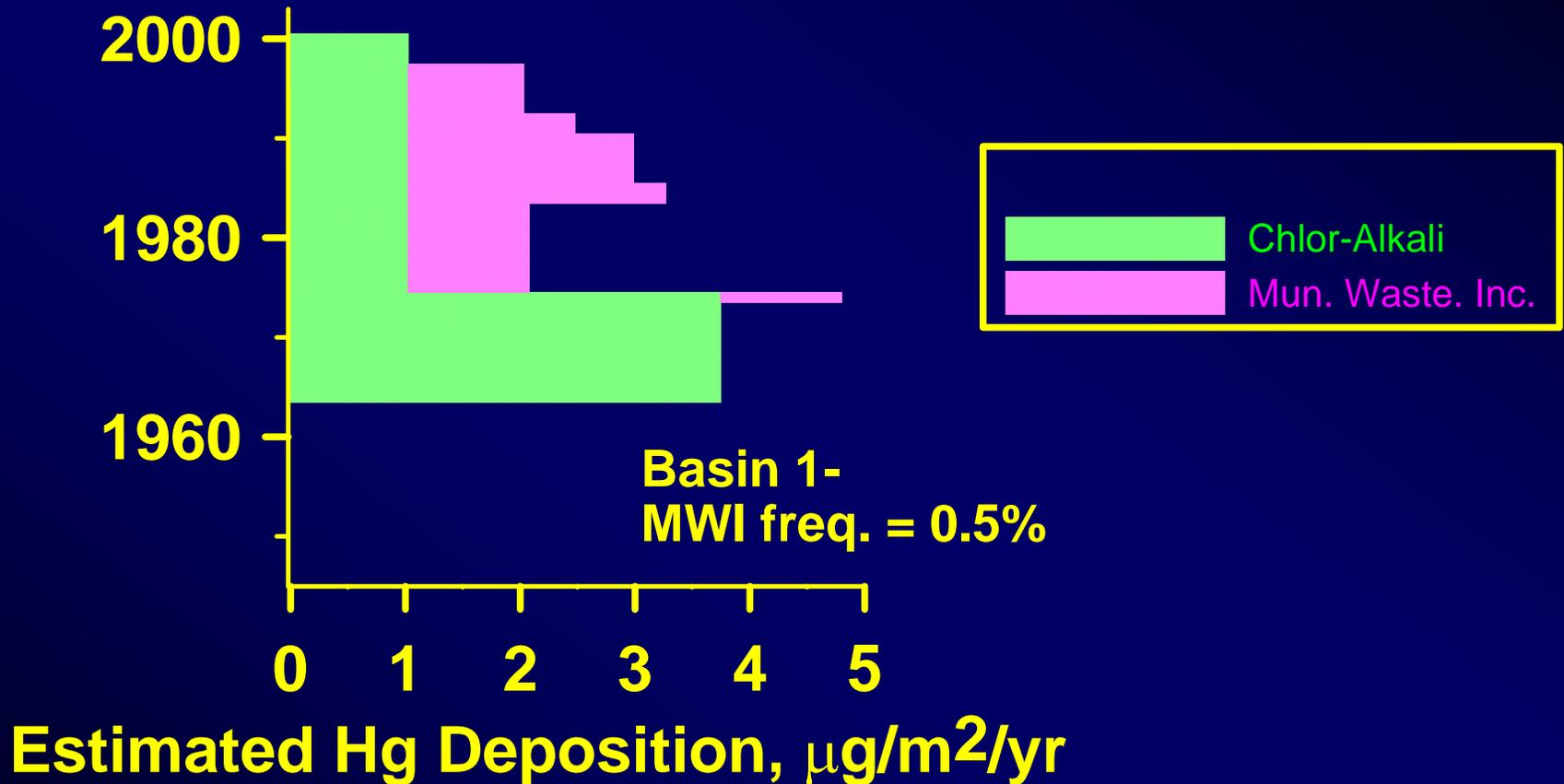
Estimated Deposition to basin 1 of Lake Whatcom from Chlor-Alkali Plant



Hg from MWI Incinerators

- **MWI at Ferndale (1974- 1997)**
 - Three levels of air pollution control
 - 40 g/hr with 70% RGM at intermediate level
- **MWI near Bellingham Airport (1984- 1997)**
 - Two levels of air pollution control
 - Hg emissions not measured
 - Assumed 25 g/hr at 70% RGM based on Ferndale MWI emission data

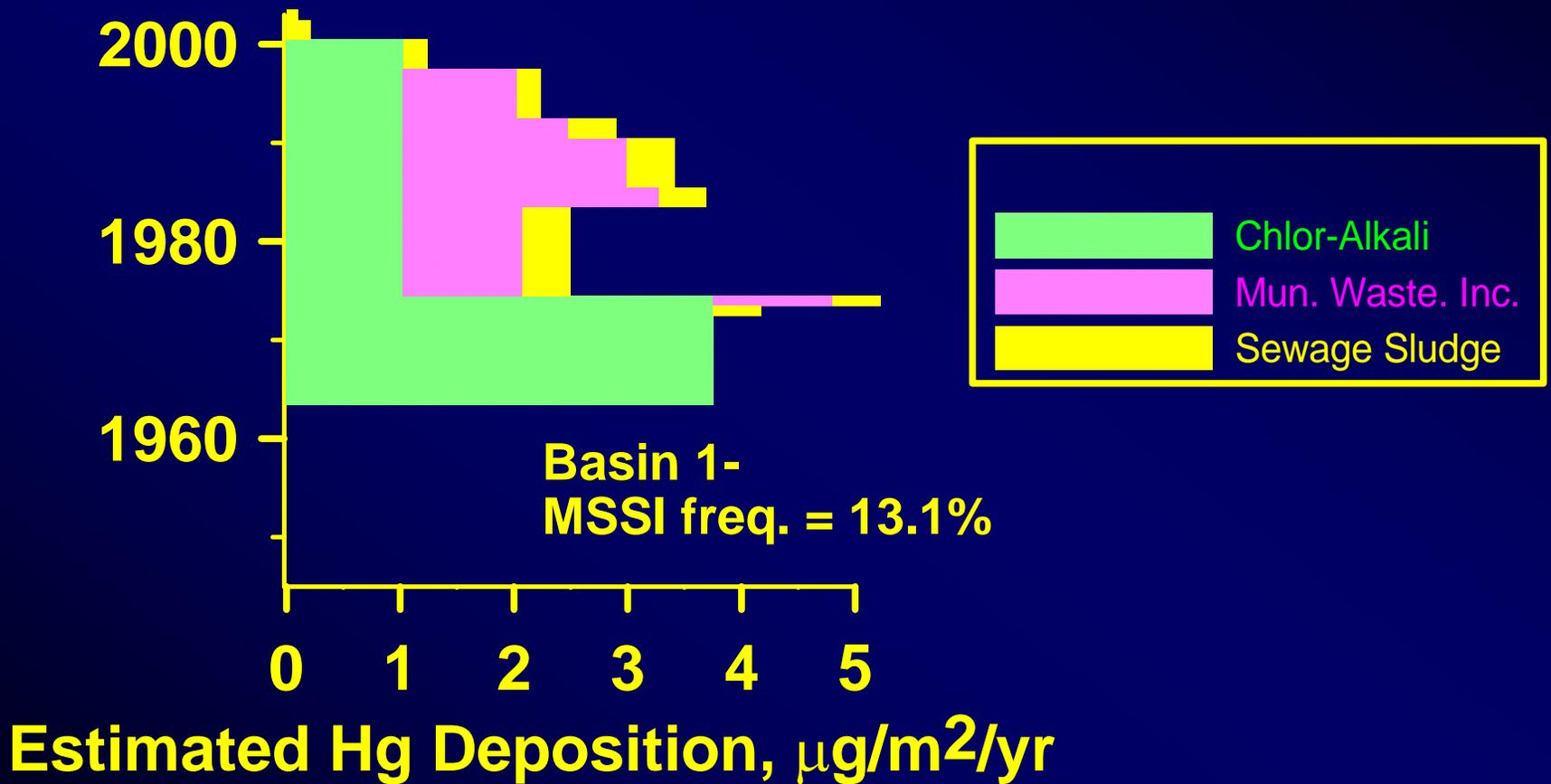
Estimated Deposition to basin 1 of Lake Whatcom from MWI and Chlor-Alkali Plant



Hg from Sludge Incinerators

- **Municipal Sewage Sludge Incinerator near Bellingham (1973 and continuing)**
 - Two levels of air pollution control
 - 3.4 g/hr at less than 10% RGM at present level of air pollution control
 - Emission decreasing due to decreased usage

Estimated Deposition to basin 1 of Lake Whatcom from MSSSI, MWI and Chlor-Alkali Plant



Deposition estimates based on models requires knowing:

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- Wind speed and direction

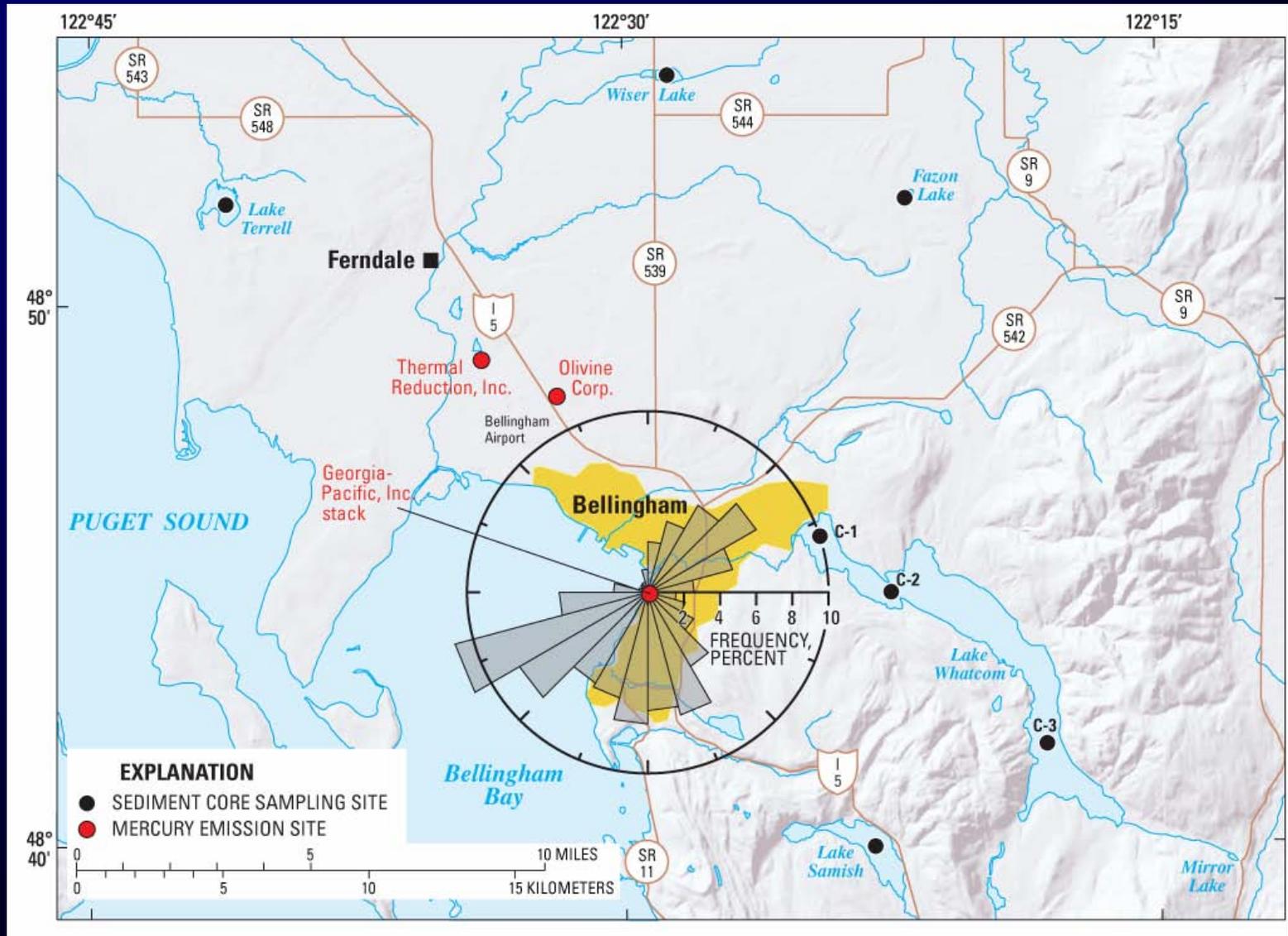
Source Dependent and Receptor Independent Factors

- Hg emission rates
- Speciation of Hg in the emissions

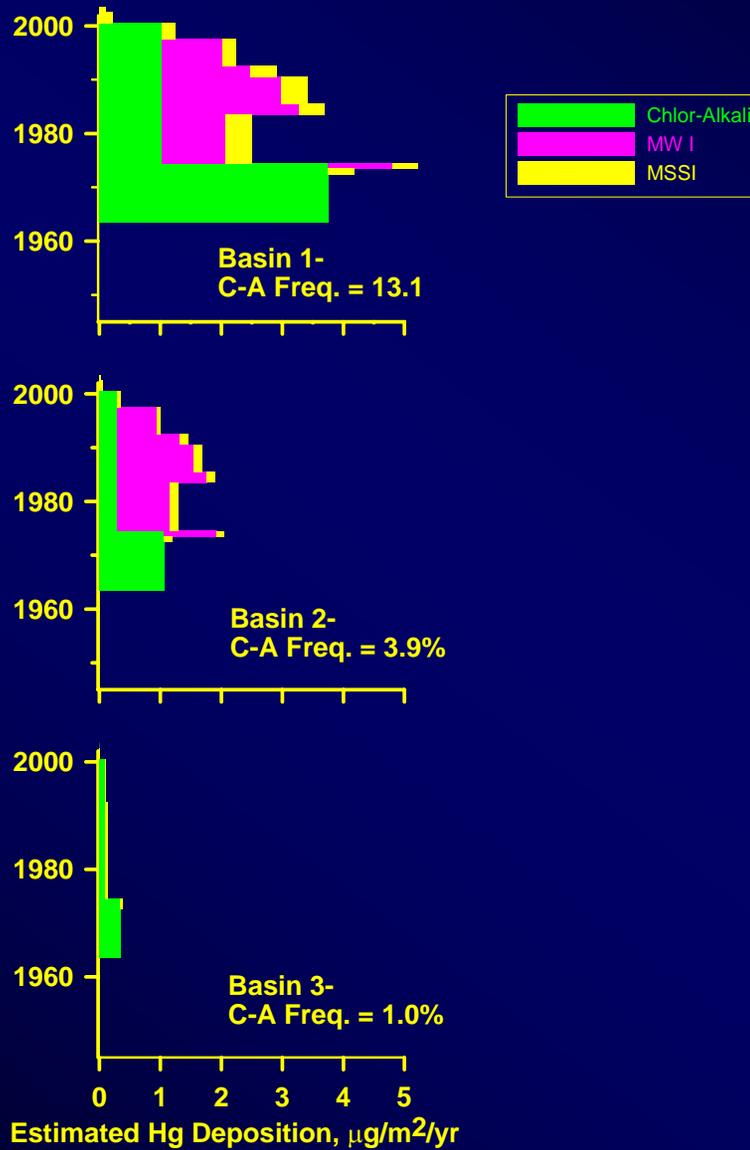
Receptor Dependent Factors

- Angle between Source and Receptor (for winds)
- Distance between Source and Receptor

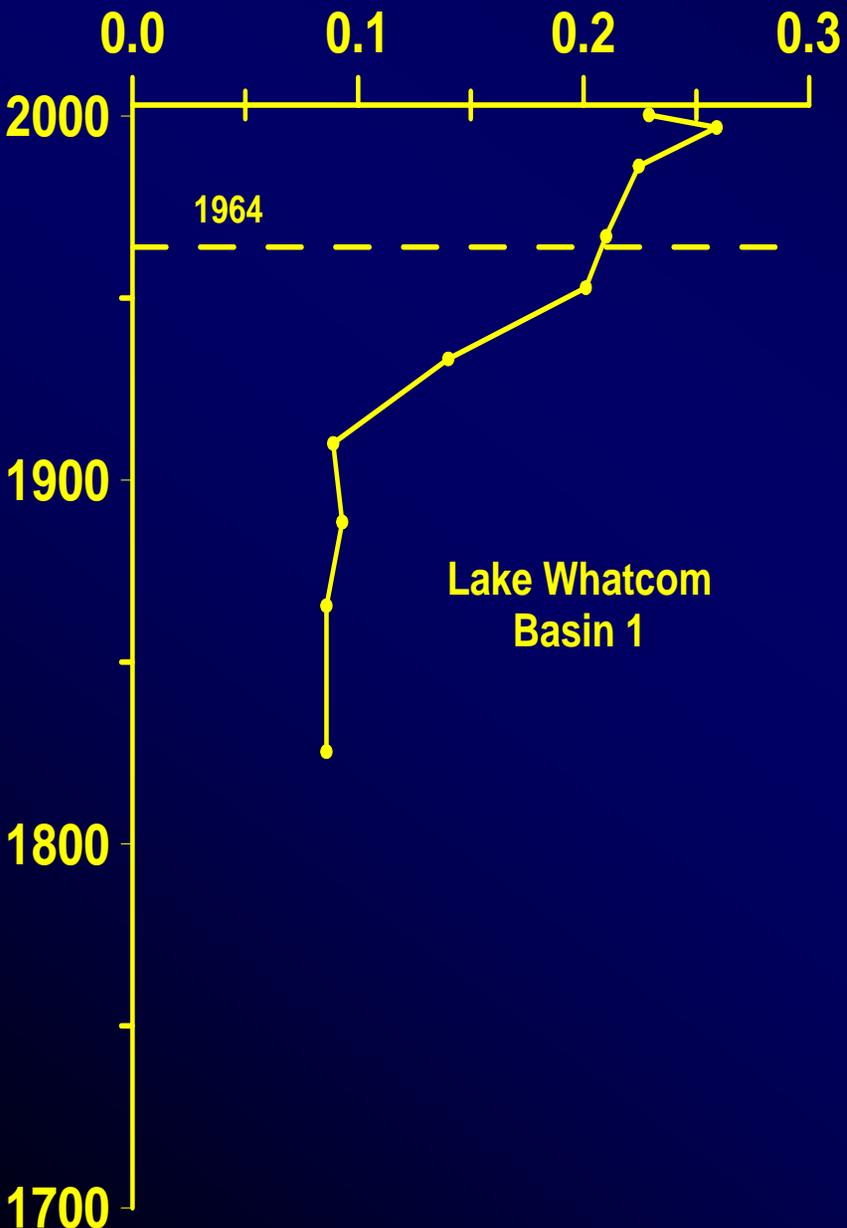
Comparing Hg Deposition with Location (angle from sources) within Lake Whatcom



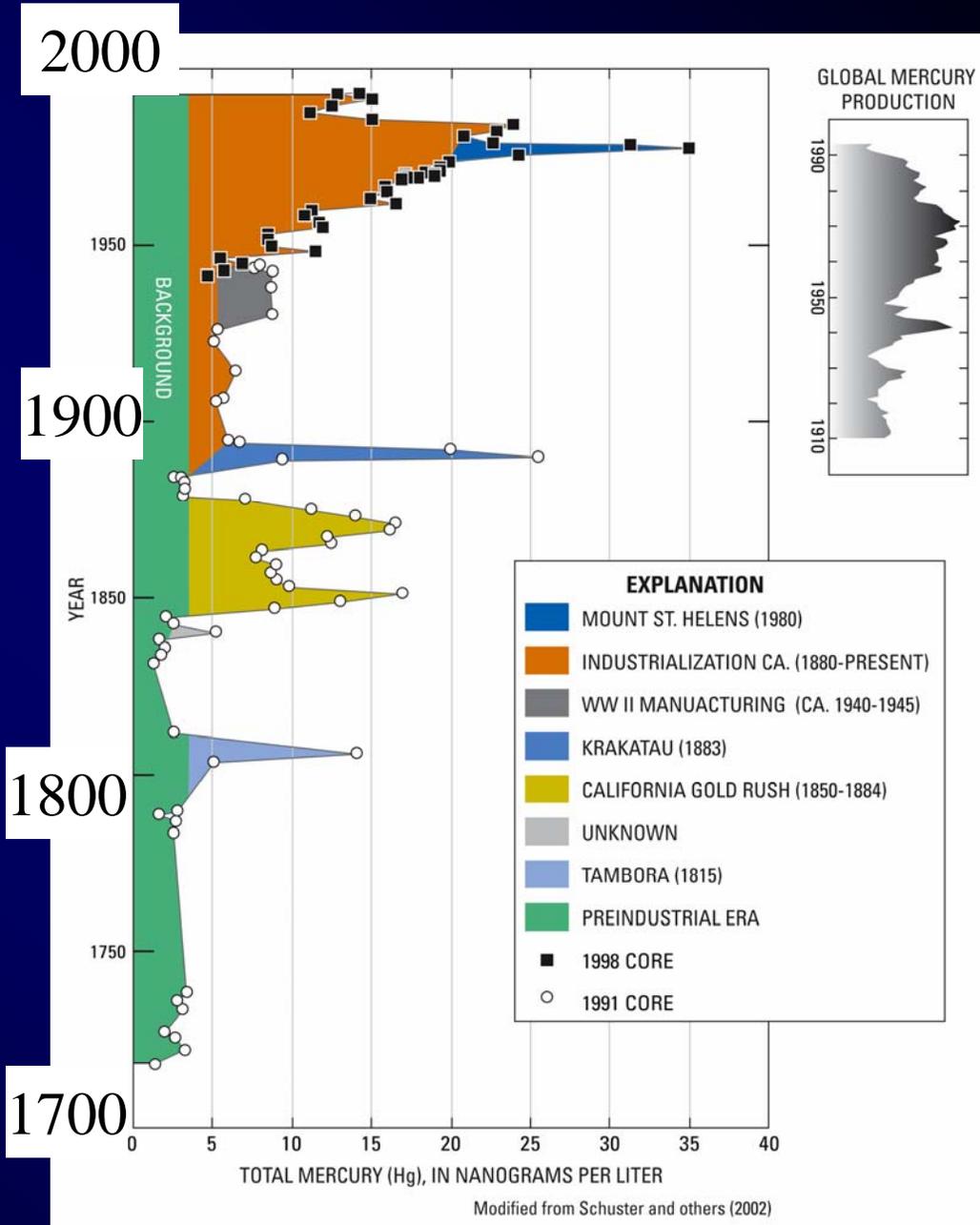
Estimated Deposition decreases down Lake Whatcom because of wind pattern



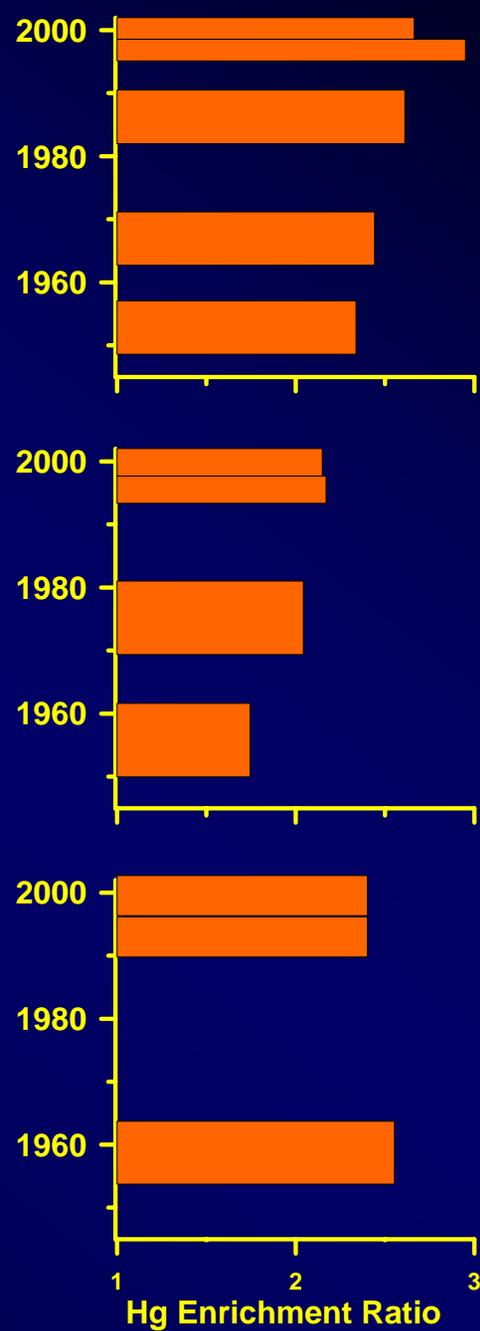
Hg Concentration, mg/kg



Lake Whatcom
Basin 1



Atmospheric Deposition



Lake Sedimentation

Deposition estimates based on models requires knowing:

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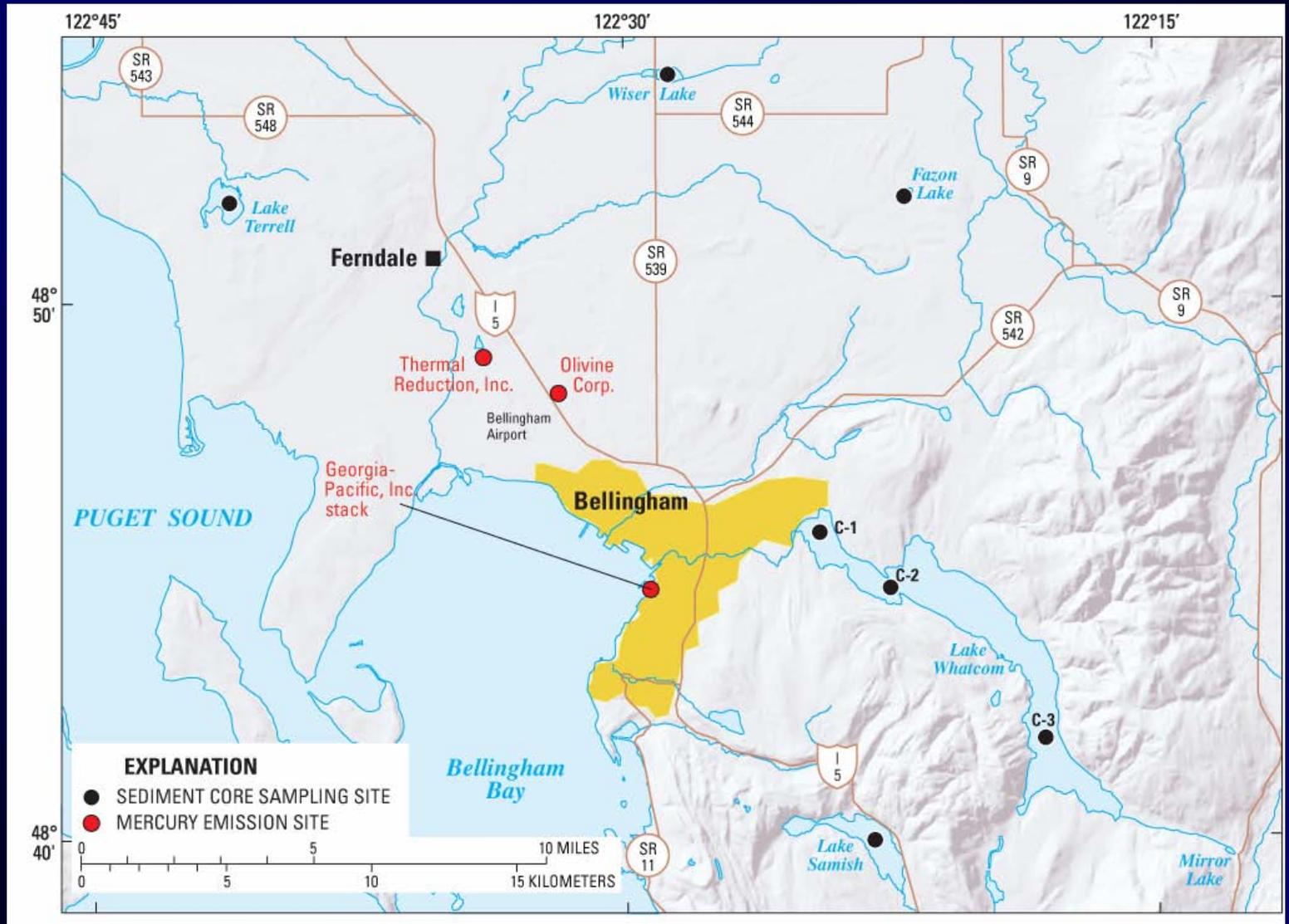
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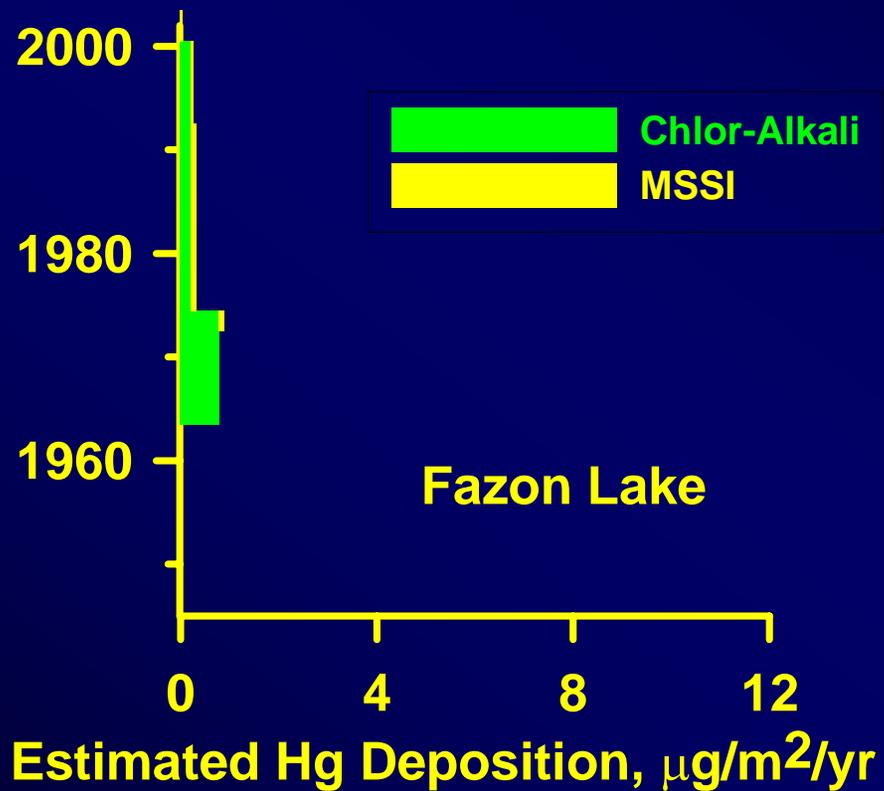
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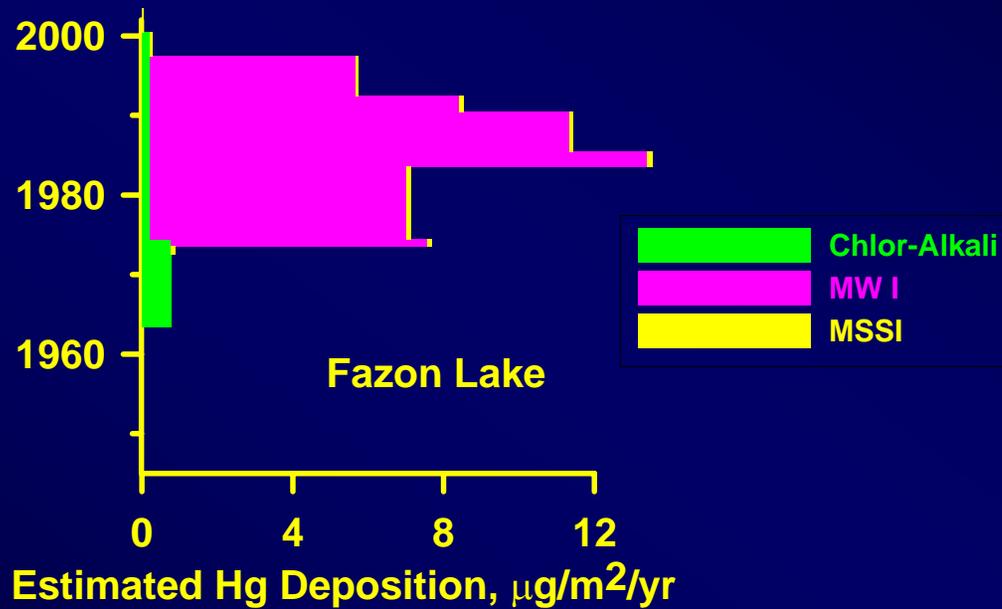
Comparing Hg Deposition to Fazon Lake from different sources



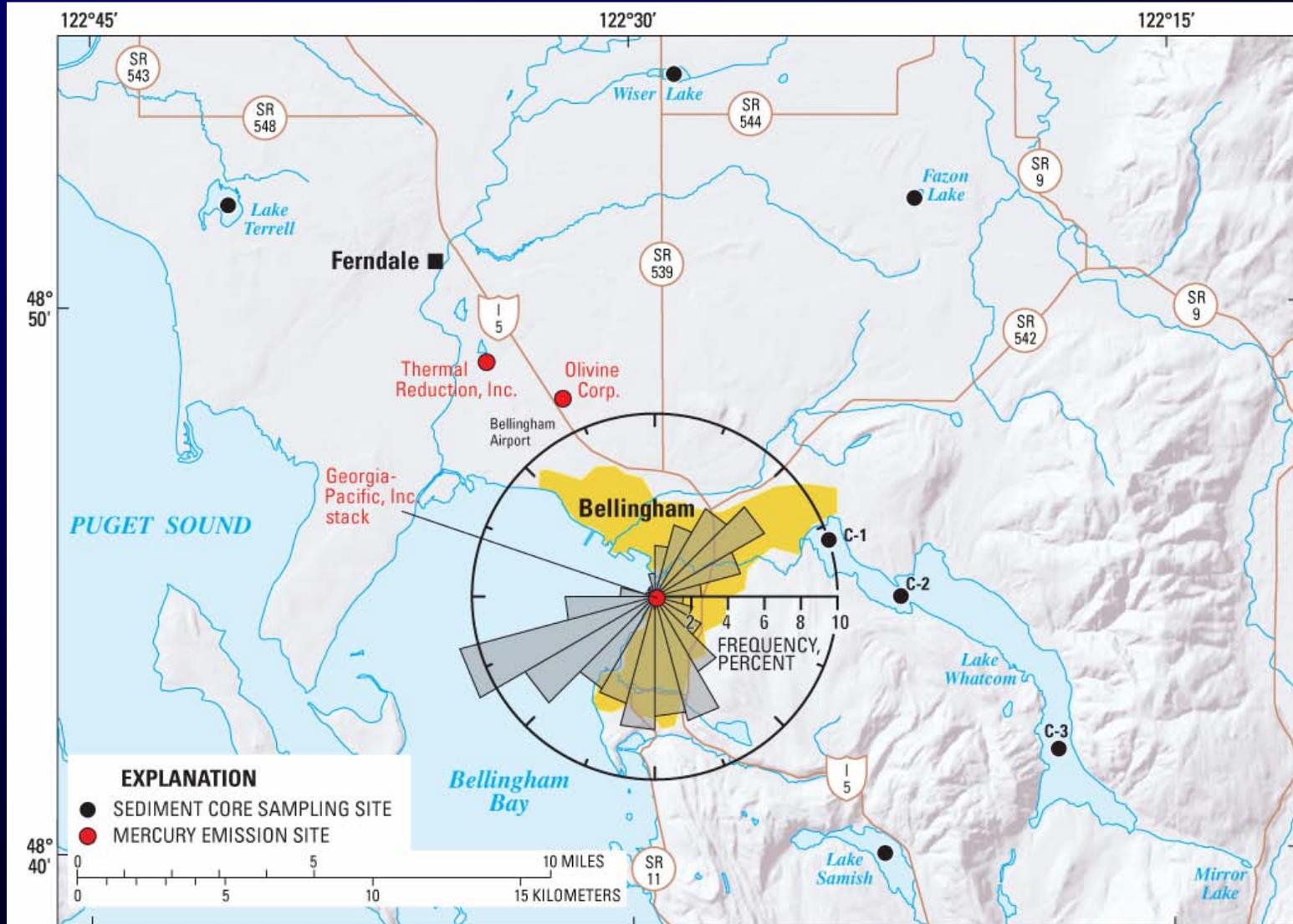
Estimated Deposition to Fazon Lake from the Chlor-Alkali Plant



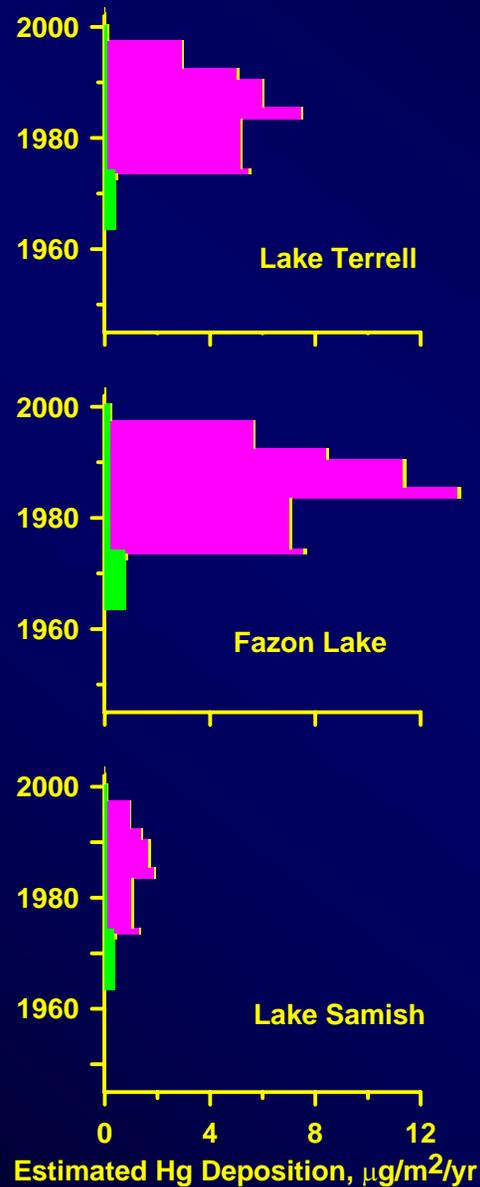
Estimated Deposition to Fazon Lake from the MWI, Chlor-Alkali Plant and MSSSI



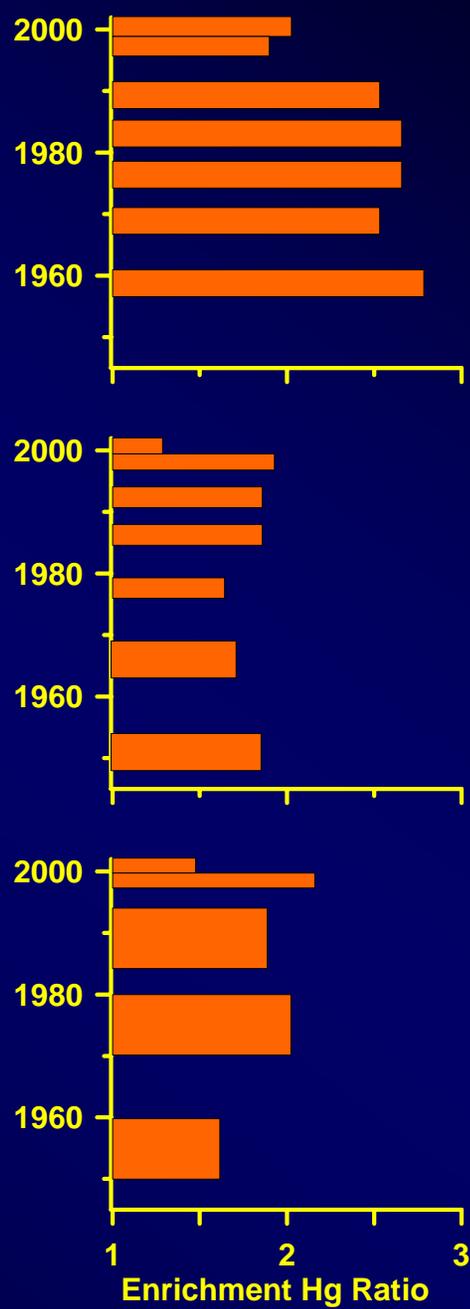
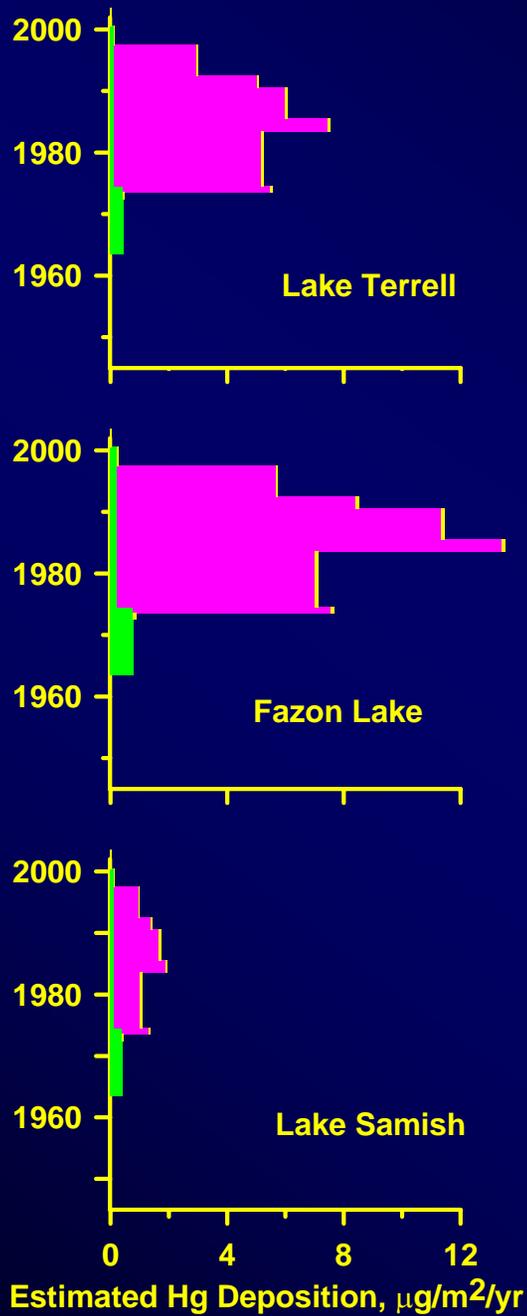
Comparing Hg Deposition to Whatcom County Lakes as a function of direction from Bellingham



Estimated Deposition to Lake Terrell, Fazon Lake and Lake Samish



Atmospheric Deposition



Lake Sedimentation

The majority of Hg in the sediments of Whatcom County lakes probably comes from global sources because:

- The sediment enrichment factor was greater than 2 before the first local Hg source began operations
- The history of Hg in the sediments does not reflect temporal changes in estimated atmospheric deposition
- The geographic distribution of Hg in sediments is not consistent with the estimated deposition from local sources